

APPENDIX B

SUMMARY OF SONIC DRILL COMBUSTION TESTS AND ENERGETICS ANALYSIS

INTRODUCTION

The possibility of initiation of energetic reactions by the sonic drill, was evaluated through tests, using simulated wastes.. These tests were designed by the DOE and its contractors and carried out at the facilities of Resonant Sonic International (RSI) in Woodland, California. (Sherwood, T.R., *Operable Unit 7-10 Staged Interim Action Stage I California Combustion Test Report (Draft)*, INEEL/EXT-99-00586, June 1999).

Of particular interest was the potential for reactions with nitrate salts and fuels, such as cutting oils and wood. Materials were placed in the path of the drill to simulate refusal conditions and corresponding heat generation. Thermocouples were used to measure temperatures near the drill bit and at other locations throughout the tests. The potential for spark generation was evaluated as well.

DESCRIPTION OF THE TESTS

Two (2) test cylinders were constructed of carbon steel. Each had a diameter of 32 inches and a length of 8 feet. The test cylinders were placed inside of a test cell filled with native soils. Each test cylinder contained a test drum, ten (10) thermocouples and other materials based their potential reactivity (nitrate salts, oils, wood chips) or their ability to cause heat generation when contacted by the sonic drill (bricks, polyethylene blocks).

The contents of the test drums (from top to bottom) were as follows:

Test Drum 1 – A top layer of soil

A simulated waste mixture consisting of

- 3.0 gallons of dry sodium nitrate
- 1.5 gallons of dry potassium nitrate
- 1.7 gallons of Chevron ISO 150 lube oil

Another simulated waste consisting of

- 4.6 gallons of dry sodium nitrate
- 2.4 gallons of dry potassium nitrate
- 1.7 gallons of Chevron ISO 150 lube oil
- Compacted soil

Test Drum 2 – A top layer of soil

A round piece of ½ inch plywood

A simulated waste mixture consisting of

- gallons of dry sodium nitrate
- 1.5 gallons of dry potassium nitrate
- 2.25 gallons of dry wood chips
- A round piece of ½ inch plywood
- Compacted soil

Each test cylinder presented the following sequence (from top to bottom) to the sonic drill:

- ½ inch steel plate with 8 inch center hole
- 1 foot 8 inches of compacted soil
- polyethylene block (2 sheets, each 2 inches thick, taped together)
- 1 foot 10 inches of soil
- 4 bricks (each 2 inches thick)
- the test drum
- 8 inches of clay
- 4 inch concrete block
- 4 inches of soil
- ¾ inch steel plate (cylinder base)

The sonic drill was operated in the rotational mode throughout the testing.

CALIFORNIA TEST RESULTS

The maximum temperatures measured were 81.8 degrees Centigrade (thermocouple 5 test cylinder 1) and 94.8 degrees Centigrade (thermocouple 13 test cylinder 2). The value for thermocouple 13 (94.8 degrees Centigrade is not considered to be reliable based on data gaps with this thermocouple.

The spark test consisted of three (3) minutes of drilling on a steel plate, with the rotational pressure increasing from 1000 psia to 1500 psia during the test. No sparking was observed, using an infrared camera.

SUBSEQUENT TEMPERATURE MEASUREMENTS AT REFUSAL CONDITIONS

In a communication from R. J. Secondo on August 27, 1999, the Panel learned that the sonic drill was evaluated under refusal conditions with two (2) 1 inch steel plates, stacked to avoid plate rotation. After 10 minutes at 100 hertz with a pull down pressure of 1200 pounds, the maximum temperature recorded, inside the tip of the drill probe, was 150 degrees Fahrenheit (65.5 degrees Centigrade). "The steel tip remained rigid, but 1/8 inch indentations were visible".

¹ Newcomer, D. R., G. V. Last, J. R. Friley, L. A. Strope, B. B. Johnson, Phase III Resonant Sonic Report, PNNL-11321, 1996

² "Comminution and Energy Consumption," National Materials Advisory Board, Publication NMAB-364, 1981.